Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2, 15, and 97 of the	)	
Commission's Rules to Permit Use of Radio	)	ET Docket No. 94-124
Frequencies Above 40 GHz	)	RM-8308
for New Radio Applications	)	

TO: The Commission

PETITION FOR RECONSIDERATION OF VORAD SAFETY SYSTEMS, INC.

VORAD SAFETY SYSTEMS, INC.

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SUMMARY

VORAD seeks reconsideration of the out-of-band emission limit adopted for vehicle radar systems operating in the 46.7-46.9 GHz band. If the limit is retained, it will effectively preclude introduction of vehicle radar for the passenger car market for several years at least, depriving consumers of the important safety features such systems would provide. By modifying the limit to incorporate the same requirements applicable to vehicle radar in the 76-77 GHz band, the Commission can remove this obstacle without creating a threat of harmful interference to government operations.

The public safety benefits promised by vehicle radar systems are uncontroverted. For example, VORAD customers using equipment suitable for commercial vehicles have experienced accident rate reductions of more than 30 percent. Vehicle radar operations in the 46.7-46.9 GHz band promise to bring these benefits to the passenger car market quickly and affordably. Specifically, VORAD has advised the Commission that it could adapt its existing equipment to operate in these bands and produce a product for passenger vehicles within a year.

However, the Commission made it impossible for VORAD to deliver on that commitment when it adopted an extremely stringent limit on out-of-band emissions for vehicle radar operating in the 46.7-46.9 GHz band. Compliance with that limit would be possible today only by decreasing system power, which in turn would directly degrade the system's safety performance. Developing technology to achieve the suppression level required will be time-consuming and costly. As a

result, this critical product will not be available in the near term at all, and may not be affordable for most consumers if and when it does come to market.

The record does not support the Commission's conclusion that this extremely strict limit is needed to protect existing and planned government operations in the 94 GHz and 140 GHz bands. To the contrary, VORAD's experience in operating vehicle radar systems at sub-harmonics of those frequencies suggests that there is no risk of interference to government operations. Vehicle radar in the 46.7-46.9 GHz band certainly poses no greater threat of harmful interference than do operations in the 76-77 GHz band. Accordingly, the Commission should apply the spurious emission limits adopted for 76-77 GHz vehicle radar to operations at 46.7-46.9 GHz as well.

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VORAD SAFETY SYSTEMS, INC.

VORAD Safety Systems, Inc. ("VORAD"), by its attorneys and pursuant to Section 1.429 of the Commission's Rules, 47 C.F.R. § 1.429, hereby submits this petition for reconsideration of the *First Report and Order* in the above-captioned proceeding, FCC 95-499, released Dec. 15, 1995, 61 *Fed. Reg.* 14500 (Apr. 2, 1996) ("*Order*"). Specifically, VORAD seeks modification of the out-of-band emission limit adopted in the *Order* for vehicle radar operations in the 46.7-46.9 GHz band.

INTRODUCTION

The *Order* authorized the commercial use of certain portions of the so-called "millimeter wave" frequencies above 40 GHz. In particular, the Commission designated spectrum at 46.7-46.9 GHz and 76-77 GHz for vehicle radar operations and spectrum at 59-64 GHz for general unlicensed use. VORAD had requested the

allocation of 200 MHz of spectrum for vehicle radar in the 46-50 GHz range. VORAD selected this frequency range because it manufactures vehicle radar equipment operating in the 24.675-24.775 GHz band. VORAD advised the Commission that by using a frequency doubler, it could adapt its existing equipment for operation in the 46-50 GHz range, permitting more rapid introduction of the new equipment at a lower cost.[1] Other parties, including the major domestic automobile manufacturers, requested the allocation of spectrum for vehicle radar at 76-77 GHz, which has also been adopted by the Europeans for this service. *Order* at 8.

The Commission originally proposed an out-of-band emission limit of 2 pW/cm^2 measured at a distance of 3 meters for all unlicensed millimeter wave devices, including vehicle radar equipment.[2] However, this limit was strongly opposed by the proponents of vehicle radar systems and other unlicensed operations, who argued that the limit would be extremely difficult to meet, as well as difficult to measure, and was unnecessary to protect other communications users. *See Order* at 20. In response to these concerns, the Commission adopted relaxed out-of-band emissions standards for vehicle radar in the 76-77 GHz band: a limit of 600 pW/cm^2 measured at a distance of 3 meters for forward-looking vehicle radar sensors, and a limit of 300 pW/cm^2 measured at a distance 3 meters for side- or

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1 *See* VORAD Reply Comments at 1 (March 30, 1995).

2 *Notice of Proposed Rule Making*, ET Docket No. 94-124, 9 FCC Rcd 7078, 7106 (1994) (hereinafter, "*Notice*").

rear-looking sensors. In addition, the Commission adopted a limit of 90 pW/cm^2 measured at a distance of 3 meters for spurious emissions by equipment operating in the 59-64 GHz band.

However, the Commission adhered to its very strict proposed limit of 2 pW/cm^2 measured at a distance of 3 meters for vehicle radar operating in the 46.7-46.9 GHz band. The Commission recognized that its decision "may have an adverse economic impact on the manufacturers of vehicle radars for the 46.7-46.9 GHz band," *Id.* at 21, but concluded that such a limit was appropriate to protect present and future government operations in the 94 GHz and 140 GHz bands.

VORAD seeks reconsideration of the Commission's decision to maintain this extremely restrictive limit for vehicle radar systems operating in the 46.7-46.9 GHz band. Simply stated, the limit directly conflicts with the Commission's stated goal of encouraging expeditious development of an important safety product. Meeting this limit at all using current technology would be possible only by reducing the vehicle radar system's operating power, significantly degrading the safety performance of the system.

Even if technology to comply with the limit can be developed, at a minimum this will delay introduction of vehicle radar systems in the 46.7-46.9 GHz band at least one to two years and result in a huge cost increase. These factors are critical because absent this severe limit, VORAD would be in a position to begin offering vehicle radar systems in the 46.7-46.9 GHz band within a year. In contrast, VORAD believes that companies interested in producing vehicle radar

systems in the 76-77 GHz band will not be ready to offer their products until 1999 or 2000. Thus, if introduction of vehicle radar at 46.7-46.9 is delayed, or if cost increases make use of this band for vehicle radar completely infeasible, this important safety product will not be available to consumers for several more years at least.

Furthermore, the evidence does not support the Commission's assumption that the strict limit is necessary to protect government operations in the 94 and 140 GHz bands. VORAD has operated vehicle radar in the 24 GHz band for several years and has been experimenting with operations in the 47 GHz band for over a year. These operations have been subject to existing Part 15 limits on spurious emissions, and VORAD has never received any complaints of interference. Furthermore, there is simply no evidence that operations in the 46.7-46.9 GHz band present more of an interference risk to government services than do operations in the 76-77 GHz band, for which a much more reasonable spurious emission limit was adopted.

For these reasons, VORAD respectfully requests that the Commission reconsider the rules adopted in the *Order* to specify the same limits for out-of-band emissions for vehicle radar in the 46.7-46.9 GHz band that it adopted for vehicle radar in the 76-77 GHz band: 600 pW/cm^2 measured at a distance of 3 meters for forward-looking vehicle radar sensors, and 300 pW/cm^2 measured at a distance 3 meters for side- or rear-looking sensors.

I. MODIFICATION OF THE OUT-OF-BAND EMISSIONS LIMIT IS CRITICAL TO PERMIT THE RAPID INTRODUCTION OF VEHICLE RADAR SYSTEMS

VORAD requested allocation of the 46.7-46.9 GHz band for vehicle radar in order to expedite introduction of a significant safety product to the passenger vehicle market. However, if the spurious emission limit on operations in this band is not relaxed, vehicle radar for passenger cars will be either completely unavailable or simply unaffordable, at least for several more years. As a result, the life-saving promise of this technology will not be realized.

A. Vehicle Radar in the 46.7-46.9 GHz Band Can Significantly Enhance Public Safety

The Commission has recognized that vehicle radar systems can perform an important safety function. As the Commission noted, vehicle radar technology "is envisioned as a key feature of the Intelligent Vehicle Highway System, which is intended to offer significant benefits to the American public by improving highway safety." *Notice* at 7090-91.[3]

The Commission's expectations regarding the impact of vehicle radar on highway safety are borne out by data from customers who have used VORAD's system in the 24 GHz band. Customers who have installed VORAD's equipment in their truck fleets have seen accidents drop by more than 30 percent. Similarly, a

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[3] The Commission also indicated its belief that permitting commercial millimeter wave operations would "stimulate new applications of radio technology for the American public, facilitate technology transfer from the military sector, and create opportunities for economic growth and jobs." *Id.* at 7081.

bus company that used VORAD's system experienced more than a 20 percent reduction in its accident rate.[4]

In order to make vehicle radar systems available to provide these safety features for passenger cars, VORAD sought an allocation of 200 MHz of spectrum in the 46-50 GHz range. VORAD's 24 GHz system is in use on trucks and other large commercial vehicles, but its antenna size is too large to be suitable for passenger vehicles. *Id.* at 3-4. VORAD selected the 46-50 GHz range for its request because it would permit rapid development of a product that could be used in passenger vehicles simply by using frequency doubling circuitry to adapt VORAD's 24 GHz system.

The Commission expressly acknowledged the value of expediting the availability of this important product. Specifically, the Commission found that building on VORAD's existing technology "could allow the relatively low cost and speedy development of millimeter wave vehicle radar systems operating near 48 GHz." *Order* at 5. Given the proven safety performance of VORAD's vehicle radar system, making equipment available to passenger cars quickly and affordably clearly is in the public interest.

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4 *See* Supplemental Comments of VORAD Safety Systems, Inc., RM No. 8308 at 2-3 (Feb. 25, 1994).

B. The Strict Limit on Spurious Emissions in the 46.7-46.9 GHz Band Will Preclude the Introduction of Affordable Vehicle Radar for Passenger Cars for Several Years at Least

The out-of-band emission limit imposed on vehicle radar equipment operating in the 46.7-46.9 GHz band will deprive the public of the safety benefits of vehicle radar designed for passenger cars for several years at a minimum. This limit can be met today only by significantly degrading system performance. Developing technology to comply with the limit in the future will be extremely costly and will substantially delay introduction of this important product.

As a number of commenting parties advised the Commission, controlling spurious emissions is quite difficult and costly. *See Order* at 20 (citing comments of VORAD, General Motors, the American Automobile Manufacturers Association and others). VORAD is not certain that out-of-band emissions could be suppressed to meet the limit for the 46.7-46.9 GHz band using today's technology. In fact, it appears that the only way to comply with the limit now would be to reduce the power transmittal in the main beam. However, this would substantially affect the system's safety performance. Specifically, the reduced power would mean that the radar system would not detect weaker targets and may miss some critical targets altogether. The effect on performance would be particularly severe in snowy or rainy conditions, which of course is when low visibility would make the system most valuable to drivers. The end result would be a reduction in the system's ability to prevent accidents and save lives.

It is possible that technology to suppress out-of-band emissions without severely limiting main beam output can be developed, but that will take time and be extremely costly. Creating and implementing a solution to the out-of-band emission limit will delay VORAD's product development by at least one to two years. This delay will effectively negate VORAD's ability to quickly adapt the equipment it has developed for operations in the 24 GHz range.

As a result, the public will be deprived of this critical safety product at least for several years. Absent this virtually unattainable limit on out-of-band emissions, VORAD would be prepared to begin marketing vehicle radar systems operating in the 46.7-46.9 GHz band within a year. In contrast, VORAD understands that development of a product to operate in the 76-77 GHz band allocated in the *Order* for vehicle radar is on a slower track. VORAD believes that equipment designed for that band will not be available until 1999 or 2000. Thus, the delay in development of a product operating in the 46.7-46.9 GHz band means that passenger vehicle radar will be completely unavailable in the near term.

Furthermore, reducing the emissions to that level will have a profound impact on product costs. Adhering to the present emission limit would require inserting special filtering in the transmission line, which in turn would produce additional transmitter and receiver losses to the system. In addition, radio-frequency shielding would need to be incorporated into the equipment packaging and cabling, and generally more demanding specifications for system components would be necessary. VORAD estimates that the total impact of these requirements

would be to increase system costs by 25-50%. A cost jump of that magnitude will clearly make the system much less affordable, and may make it completely uneconomical to produce and market.

Even if the impact on system costs does not make equipment in the 46.7-46.9 GHz band commercially infeasible, at a minimum it will limit the number of customers that can afford to purchase the product. In addition, the increased cost of complying with the limit will also put VORAD and any other prospective manufacturers of vehicle radar systems in the 46.7-46.9 GHz band at a tremendous competitive disadvantage once systems operating in the 76-77 GHz band are available. Because the emission limits adopted for vehicle radar at 76-77 GHz are much more reasonable, manufacturers of equipment in that band will not face these substantial costs in designing equipment to meet the standards adopted by the Commission. The huge differential in manufacturing cost will make it extremely unlikely that vehicle radar systems operating in the 46.7-46.9 GHz band could be price competitive with those operating in the 76-77 GHz band.

By allocating the 46.7-46.9 GHz band for vehicle radar the Commission could have made possible the expedited introduction of a proven safety product for the passenger vehicle market. However, unless it is modified, the extremely restrictive limit on out-of-band emissions adopted by the Commission will deprive consumers of the benefits of vehicle radar systems, at least for the next several years. As a result, the impact that such systems could have had in reducing accidents will not be felt. VORAD urges the Commission to reconsider its decision

and adopt the same out-of-band emission limit for vehicle radar in the 46.7-46.9 GHz band that it applied to the 76-77 GHz band.

II. THE ADOPTED LIMIT ON OUT-OF-BAND EMISSIONS IS NOT TECHNICALLY JUSTIFIED

The *Order* does not provide a sufficient technical justification for imposing such a strict limit on out-of-band emissions for vehicle radar devices in the 46.7-46.9 GHz band. This limit is much more severe than the limits adopted for comparable vehicle radar devices in the 76-77 GHz band, as well as the limits imposed on Part 15 devices generally.

The Commission based its decision to maintain such a severe restriction on out-of-band emissions for 46.7-46.9 GHz vehicle radar on the need to protect existing and future government uses of the 94 GHz and 140 GHz bands. However, the evidence in the record does not demonstrate that there is a real threat of interference to such uses by vehicle radar systems.[5]

VORAD's significant experience in vehicle radar operations suggests that concerns about interference to government operations are unfounded. For example, over the past two to three years VORAD has had over 2000 vehicle radar systems operating in the 24 GHz band with no reported or detected interference to any known spectrum users. Although the fourth harmonic of these systems is near

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[5] As General Motors explained in its comments, vehicle radar systems use highly directionalized antennas and will primarily be used on the nation's highways. This significantly decreases the potential for interference to the airborne sensors proposed for use in the 94 GHz and 140 GHz bands. *See Order* at 20.

the 94 GHz band, there has been no evidence of interference to government operations in that band. In addition, VORAD has operated engineering prototype units at 47.3 GHz for over a year under an experimental license, again with no reported interference to government or any other users.

These systems have been operated pursuant to existing Part 15 rules, which have an out-of-band suppression requirement of 50 dB. VORAD's experience thus demonstrates that this standard for spurious emissions is adequate to protect other spectrum users.

Furthermore, there is no evidence that interference from 46.7-46.9 GHz vehicle radar equipment is any more likely than interference from 76-77 GHz vehicle radar equipment, which is subject to much less stringent out-of-band emission limits. Particularly in the initial stages of development of 76-77 GHz vehicle radar devices, it is likely that transmitter designs will employ 38 GHz or 26 GHz fundamental oscillators and use frequency doublers or triplers or second or third harmonic pumped oscillators to achieve the desired 76-77 GHz frequency. In that event, there will be harmonics of the fundamental 76-77 GHz frequency (or more accurately of the underlying sub-harmonic frequency) that could also generate emissions near the 94 GHz or 140 GHz bands. These emissions could be of similar power levels as the harmonic emissions from operation of 46.7-46.9 GHz vehicle radar equipment.

In addition, vehicle radar in the 76-77 GHz band will create spurious radiation over a much larger range of spectrum than will operations in the 46.7-

46.9 GHz band. The narrow 200 MHz beamwidth of transmissions in the 46.7-46.9 GHz band will limit the bandwidth of harmonic emissions as well. In contrast, the bandwidth of vehicle radar in the 76-77 GHz band is five times as large at 1000 MHz. As a result, these systems will produce spurious emissions over much more of the frequency spectrum due to intermodulation frequency products than will be produced from the narrow 46.7-46.9 GHz band.

VORAD strongly agrees with the Commission's finding that emission limits of 600 pW/cm^2 measured at a distance of 3 meters for forward-looking vehicle radar sensors, and 300 pW/cm^2 measured at a distance 3 meters for side- or rear-looking sensors are appropriate for vehicle radar in the 76-77 GHz band. However, because the risk of interference is similar, the Commission should adopt the same limits for vehicle radar in the 46.7-46.9 GHz band.

The *Order* incorrectly assumed that placing a strict limit on out-of-band emissions for vehicle radar in the 46.7-46.9 GHz band was needed to protect government applications in the 94 GHz and 140 GHz bands. Modification of this limit to make it consistent with the limits for 76-77 GHz vehicle radar systems will not pose a significant threat of interference to government operations.

CONCLUSION

The Commission's decision to impose an unnecessarily strict out-of-band emissions limit on vehicle radar operations in the 46.7-46.9 GHz band will deprive the public of an important safety product that could otherwise be brought to market very quickly. As a result, the accident reduction benefits of vehicle radar for

the passenger car market will not be realized, at least during the next several years. By modifying the limit to be consistent with the limits adopted for vehicle radar at 76-77 GHz, the Commission can remove this obstacle without creating significant interference to government uses of spectrum in the 94 GHz and 140 GHz bands. Accordingly, VORAD respectfully requests that the Commission reconsider the out-of-band emission limit adopted in the *Order* for 46.7-46.9 GHz vehicle radar devices.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing Petition for Reconsideration of VORAD Safety Systems, Inc. were served by hand delivery this 2nd day of May, 1996 to:

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